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INK JET PRINTER

(Inku jetto purinta-)

Tsuneo Hiroshima et al

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Inventor	:	Tsuneo Hiroshima
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Specification

1. Title of Invention

Ink jet printer

2. Scope of Patent Claims

1. An ink jet printer consists of a combination of a ink jet device having nozzles for spraying and printing the ink on the paper used for recording and a fixing device that is made up of a pressure roller and a heating plate or heated roller for fixing the aforementioned printing surface.

2. The printer of Claim 1 is characterized in that the main component in the ink is oil based dye, heat cross linking resin, liquid fatty acid or its derivative, the aliphatic hydrocarbon and silicon oil and the oil base ink have a viscosity of below 10 cps.

3. Detailed explanation of the invention

(Industrial field of use)

The invention pertains to an ink jet printer for recording the output from various measurement devices, computer, word processor, etc.

[Prior Art]

[1] Numbers in the margin indicate pagination in the foreign text.

A print is obtained by spraying and printing ink from the nozzles onto the paper used for recording in a conventional ink jet printer equipped with nozzles for ink jet. In this case, the fixing after the printing is performed by using the ink that vaporizes easily in a solvent or using an ink that absorbs the solvent into the paper and drying naturally. On the other hand, the desire in recent years has been to speed up the recording and to improve the performance of these materials. However, there is limit to the performance improvement. For example, when the easily vaporizes solvent is used, the ink get stuffed in the spraying of the nozzles which presented a problem. Also, when using the paper used for recording that is solvent absorbent, that is, the oil absorbing is excessive when using the process paper. The production cost is increased.

Also, the drying becomes a problem for color - recording which requires heavy printing of ink on the paper.

[The problems resolved by the invention]

The purpose of the invention is resolve the problems in the conventional technology and offer an ink jet printer that can dry color - recording better, the printing can be performed at high speed by providing a special heat fixing

device in the ink jet printer so excellent fixing can be obtained in standard paper. Therefore, the printing can be obtained less expensively.

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[Constitution and action of the invention]

An ink jet printer of the invention consists of a combination of a ink jet device having nozzles for spraying and printing the ink on the paper used for recording and a fixing device that is made up of a pressure roller and a heating plate or heated roller for fixing the aforementioned printing surface.

An example of the printer of the invention is shown in figure 1. A in the figure is the ink jet device consisting of the multinozzle head 1 and the ink solution chamber 2. B is the fixing device consisting of a pressure roller 5 and a heat roller 4 containing a heater 3. P is the paper used for recording. 6 is the platen roller. It is set on the platen roller 6. Ink from the ink solution chamber 2 are sprayed and inked into dots from the nozzles of the nozzle head 1 on the paper P used for recording that advances in the direction of the arrow simultaneously with the rotation of the roller. Next, the paper used for printing is introduced between the heated roller 4 and the pressure roller 5 placed to press into this. The printing surface is

heat fixed by the heated roller 4 heated by the heater 3. Furthermore, the surface of the heated roller 4 is coated with fluoride resin to improve the mold separation property.

The fixing device used in figure 1 heat fixed the printing surface of the paper directly onto the heated roller 4 side but it is preferred that the heat fixing is performed from the bottom surface of the printing surface. This example is shown in figures 2 and 3. The fixing device of figure 2 is the type that performs the heat fixing from the bottom surface side of the printing surface by the pressure rollers 15a, 15b and the heated roller 14 containing the heater 13. Also, the heated plate 24 containing the heater 23 shown in figure 3 is used instead of the heated roller. Similar to the pressure roller 25, this is the type where the heat fixing is performed from the bottom side of the printing surface. In addition, the fixing device shown in figure 1 is used, the heat fixing is performed from the bottom surface instead of the top of the pressure roller 5 and the heat roller 4. However, considering the marking and the energy of the ink, it is preferred that the fixing device shown in figure 1 with the surface heating pressure type is used.

Next, the ink used in the ink jet printer of the invention is explained.

The function of the ink is to provide a print that has good concentration and there is excellent fixing property by the ink jet printer of the invention and good drying property. In addition, it is desired that the ink does not stuff the outlet part of the nozzles. In addition, it is preferred that it is difficult to generate foaming in the ink. To obtain such a good performing ink, it is preferred that the oil base ink is used with the use of an organic solvent. Furthermore, for the water base ink, foaming is generated easily in the flow path of the ink so it is difficult to remove the foaming. The main solvent for the preferred oil base ink of the invention is the use of a silicon oil type supplementary solvent, a humidity enhancing solvent, a resin for fixing and a color dye.

The organic solvent which is the main solvent must have satisfactory conditions such as high solubility in the humidity enhancing agent and dye, low vapor pressure so it becomes difficult to foam. Therefore, an aliphatic group of hydrocarbon is preferred. Specifically, the aliphatic group of hydrocarbon having a straight chain or a side chain such as octane, nonane, decane, undecane, dodecane, tridecane

and tetradecane. These can be used alone or mixed together. The addition amount is 30 % - 70 wt. % of the total ink amount to obtain ink of low viscosity but preferably 30 - 50 wt. %.

The purpose of the humidity enhancing agent (supplementary solvent) is to prevent the stuffing in the nozzle by dissolving the dye and to reduce the speed of the evaporation of the other solvent components in the ink and to reduce the vaporization pressure of all the ink. Therefore, this humidity enhancing agent has high solubility in the dye. It is a good organic solvent with low vaporization pressure. The liquid aliphatic acid or its derivatives are preferred. For example, polyethylene glycol ether is preferred. The specific examples are oleic acid, linolenic acid, polyethylene glycol mono-oleil ether. The addition amount of the humidity enhancing agent is preferred to be 10 - 30 wt. %. If it is less than this range, the nozzles are blocked easily. Also, it is too much, the viscosity of the whole ink is too high which is undesirable.

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An example of the supplementary agent is the use of silicon oil, to improve the solubility, a large amount of the humidity enhancing agent is added. When the silicon

oil is not added, the addition amount of the humidity enhancing agent is increased to a limit of 5 - 30 wt. % but it can be increased to 10 - 60 wt. % by the addition of the silicon oil. The required conditions for this silicon oil is that it is compatible with the main solvents and the humidity agent. The addition amount of the humidity agent is added so the ink viscosity is not raised and to increase the solubility of the oil base dye. The specific examples are dimethyl silicon (KF-96L made by Akira Silicon Co.), methyl phenyl silicon (KF-56 and KF-58 made by the same company), the alicyclic dimethyl polysiloxane (KF-994, KF-995 made by the same company).

The dye must have high solubility in the main solvent and the supplementary solvent similar to the above and the oil based dye that is used can exist in a stable manner in the ink over a long period of time. The examples of the dye are such as nigrosine base EX, HR-2L, AP-2, AP-8, AY-8, 185L, 308L, 7BL (all of them made by the Orient Chemicals Co.). The addition amount of nigrosine is an amount that can obtain sufficient contrast. Since the blockage in the nozzles occur easily if it is in the saturated state, it is preferred not to exceed 20 wt. %.

The resin used for fixing must have high solubility in the main solvents described above and in the supplementary

solvent. It is compatible with the dye so a heat cross linked resin is used. The specific examples are such as alkyd resin (Becozole J-820 made by Dainihon Ink Chemical Co.), rosin modified maleic acid resin (Becasite F-231 made by the same company), rosin modified polyester (RM-1000 made by Hitachi Chemical Co.), Styrene modified alkyd resin (Styrezole 4440 made by Dainihon Ink Chemical Co.). The addition amount of these resin is 10 - 50 wt. % but preferably 10 - 25 wt. %.

Furthermore, the following production method is preferred for producing the ink. First, a fixed amount of supplementary solvent is introduced into a vessel that is equipped with a convection flow device and an agitator, an oil base dye is added gradually while agitating. The vessel is heated gradually, the main solvent is heated while dissolving the dye sufficiently, the internal temperature of the vessel is kept constant at 80 degree C, it is agitated continuously for 6 hours. After it is cooled to room temperature, the resin used for fixing is dissolved. After it has been left aside for about 24 hours, it is filtered by a milli Teflon filter of about 1 micrometer, the target ink is obtained.

[Implementation example]

The invention is explained below according to the implementation example. Furthermore, the % indicates wt. %.

Implementation example 1

Nigrosine base HR-2L	6.5 %
Nigrosine base AP-2	3.5 %
Oleic acid	20 %
Becozole J-820	20 %
Silicon oil	10 %
N - dodecane	40 %

The above chemicals are used to obtain the ink of viscosity of 6.8 cp (20 degree C), the surface tension is 33.0 dyne/cm. This is filled into a multinozzle head 1 (made of polysulfone) from a liquid chamber 2 of the ink jet device A shown in figure 1. On the other hand, the paper P used for recording is set in the platen roller 6. After printing by the ink jet, it is heat fixed by going through between pressure roller 5 and heat roller 4 of surface temperature of 160 +/- 20 degree C. A fixed black recording of high quality and fresh print is obtained.

Furthermore, the drying time for the ink on the recording paper after printing is within 5 seconds, a good drying speed is displayed. Also, the ink of the above composition is filled into a boro-silicated glass vessel.

It is sealed and left aside for 3 months under high temperature of 70 degree C and the generation of any insoluble substance in the ink was not observed. In addition, the generation of air bubbles inside the flow path under high temperature can be controlled as compared to the conventional ink by the low vaporization pressure. Also, the air bubbles can be removed with a simple operation if any air bubbles are generated.

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Next, after the printing is fixed for 30 minutes similar to the use of the ink jet printer shown in figure 1, the nozzle are left for about 100 hours in the atmosphere and ink is re-sprayed. A high concentration of print can be obtained without blockage of the ink from the implementation example. Also, the ink stability can be maintained at high temperature. When it is left for 8 months under a temperature of 70 degree C, the ink is extremely stable and the generation of insoluble substance was not recognized.

Implementation example 2

Nigrosine base HR - 2L	10%
Nigrosine base AP - 2	0.5%
Oleic acid	20 %
Beccasite F-231	20 %

Silicon oil	15 %
Isobar - H	34.5 %

These chemicals are used to produce ink of viscosity 7.0 cp (20 degree C) and surface tension of 30.0 dyne/cm.

This printing and fixing are performed similar to implementation example 1 using this ink. Similarly, a good result is obtained. Also, this ink displayed superior property similar to the ink of Implementation example 1.

Implementation example 3

Nigrosine base HR - 2L	13.5%
Nigrosine base AP - 2	0.5%
Oleic acid	21 %
RM-1000	20 %
Silicon oil	15 %
Isobar - L	30 %

These chemicals are used to produce ink of viscosity 6.5 cp (20 degree C) and a surface tension of 31.5 dyne/cm.

This printing and fixing are performed similar to implementation example 1 using this ink. Similarly, a good result is obtained. Also, this ink displayed superior property similar to the ink of Implementation example 1.

Implementation example 4

Nigrosine base HR - 2L	13.5%
Nigrosine base AP - 2	0.5%

Oleic acid	21 %
Styrezole	20 %
Silicon oil	15 %
Isobar - L	30 %

These chemicals are used to produce ink of viscosity 4.0 cp (20 degree C) and surface tension of 33.4 dyne/cm.

This printing and fixing are performed similar to implementation example 1 using this ink. Similarly, a good result is obtained. Also, this ink displayed superior property similar to the ink of Implementation example 1.

[The action effect of the invention]

The heat fixing device consisting of the pressure roller and heating plate or heating roller are mounted behind the ink jet device in the ink jet printer of the invention so after printing on the paper used for recording, it can be heat fixed directly, the printing can be performed at high speed and the drying is excellent in the color recording. Also, since excellent fixing is displayed for standard paper, an inexpensive print can be offered. In addition, since the heat fixing device described above is used, heat can be provided effectively to the paper used for recording, excess heat consumption can be controlled. Also, the vaporization of the water in the paper used for recording is different in the system

where high temperature environment is used and the system where the paper used for recording is on the heating plate. Therefore, there is shrinkage in the paper used for recording and a poor recording is obtained. However, with the heat application fixing system like the one used in the invention, the paper used for recording is heated uniformly. Also, there is glossiness generated due to the pressure of the pressure roller which produces desirable result.

On the other hand, if the oil base ink is used as the ink, there is no blockage in the nozzle at high concentration printing. Also, air bubbles that are generated on the water base ink is not observed here. Since the air bubbles that are generated on the flow path are difficult to remove, the ink jet recording ink of the invention resolved this problem. Also, if the heat cross linked resin is used as the resin component of the ink, the bonding force of the paper with the ink is increased due to the bonding of the ink by heating during the fixing process. The ink adhesion to the heated plate surface or the heated roller can be prevented. The fixing of the recording can be obtained with good quality. Similarly, when the heat cross linked resin is used, since the printing can be fixed without vaporizing the solvent that

is present inside the ink completely, the fixing temperature can be controlled to a low temperature which is economical. Also, the odor due to the solvent vaporizing can be controlled to a minimum. Also, the odor of the ink cannot be controlled totally. In addition, it has good chemical stability at a normal temperature. A good quality ink can be obtained since it has good stability in the printer, it has good shelf life and only vaporizes during heat fixing.

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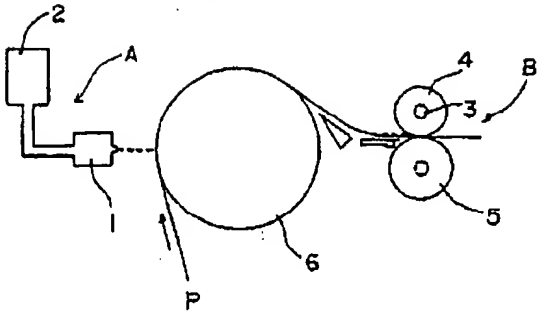
4. Brief explanation of the diagrams

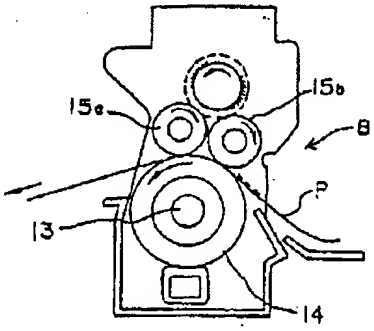
Figure 1 is the constitution diagram of an example of the printer of the invention. Figure 2 and figure 3 are the cross sections of the fixing devices of an example used in the printer of the invention.

1 - multinozzle head, 2 - ink solution chamber, 3,13,23 - heater, 4,14 - heat roller, 5,15a,15b - pressure roller, 25 - heating plate, A - ink jet device, B - fixing device, P - paper for recording

第 1 図



第 2 図



第 3 図